Review of Opinion on Winter Construction

Is it really Ever too Cold to Build?

Winter-Time Bargains for Builders and Owners

Changes in Art of Construction

How Contractors Defeat Cold Weather

Is it *Really* Ever too Cold to Build?

A DIGEST of opinion taken from government reports, engineers, architects, contractors, and leading building journals shows that the building industry as well as the public no longer believes that it is necessary to suspend construction work during winter weather. Government records show that there are but few days in the average winter when temperatures are near zero during working hours even in cities so far north as Chicago, New York or Boston.

"Custom, not climate, is mainly responsible for seasonal idleness in the construction industries" reports the committee which Secretary Hoover appointed to investigate the situation.

Quoting from the report we read that:

"The burden of idleness falls most heavily not on the producers and distributors but on the employes and the public. Construction costs are high in part because of the seasonal hazard which affects each step of the construction process from felling timber, quarrying rock, manufacturing brick, cement, tile, plaster, and a hundred and one other commodities, transporting these materials by railway, waterway, and highway, distributing them through retail supply dealers, clearing of site and excavating, to the completion and furnishing of the finished building. Idle time represents waste and direct losses to the construction industries, the workers, and the public."

(Photo by Underwood & Underwood)

Herbert Hoover has been untiring in his efforts to promote year 'round construction

Turning to another cabinet official for information, James J. Davis, Secretary of Labor, says that "more than 11,000,000 of our people are dependent for their living on the construction industry." And from a survey of normal conditions in Boston by a *Building Congress* we learn—

"That the workmen in the industry are, on an average, occupied for about 75 per cent of the time, or nine months a year. During the time when they are employed they must be paid enough to support them and their families in the idle period, the equivalent of an enforced three months vacation with pay. The Congress estimates that this costs the owners of property and renters in Boston $10,800,000 annually."

From these figures the loss to the people in Boston caused by seasonal idleness in the construction industry is found to be $14.80 per capita per year and if the average loss per capita in Boston resulting from seasonal idleness is applicable to the nation as a whole, the people of the United States pay out $1,564,360,000 annually to support those engaged in the construction industries and their families during such periods of unnecessary idleness. This would build 52,000 miles of permanent highway pavement each year or erect 31,000 schools at $50,000 each.

As the *Constructor* sees it, "The construction industry has a remarkable opportunity to engage in valuable foresight in connection with the winter building campaign at this particular time. Every word now spoken and every action now taken to aid the effort to eliminate seasonal depression will show its effect in months to come."

D. Knickerbocker Boyd, President of the Philadelphia Building Congress discusses in *Engineering News-Record* the causes of inactivity in construction in the winter months, saying that:

"More possible working days are lost by workers in the building 'trades' than by those in almost any other industry.

"The year's work is literally 'shot to pieces' by intermittency, due to unemployment, not only from seasonal causes, which for the most part could be overcome, but from other causes many of which are related. Among them is (1) indoor work so often unnecessarily required to be done in warm weather and in a crowded construction period when it could be deferred till colder weather and a lowered employment period, (2) demolition not being started until the time of the year that the new construction which replaces the old should itself be under way, (3) lack of foresight in ordering or assembling materials or fabricated products in advance of construction needs, (4) delays in closing contracts with subcontractors sometimes unfortunately due to the other unfair practice of 'shopping' for lower estimates."

The Hoover Committee finds that the situation is bad from the employer's standpoint, since available statistics from all elements of the building industry show that the average workman is forced to idleness during anywhere from 25 to 35 per cent of the year. This means that good mechanics are out of work and looking for work during three or four months of the year, using up the savings they have laid aside during the busy season.

The slackening of construction affects not only labor but material dealers and contractors as well. The Report goes on to say:

"That there are months when sales of most building materials drop off sharply is indicated by replies from dealers all over the country. Four hundred questionnaires were sent out, asking for 1922 sales of various materials month by month. The general high level of sales for practically all materials, as shown by the replies received, comes in the five months from June to October. From the latter month there is a rapid decline which reaches a low point in January or February. The volume of sales then starts to pick up and increases steadily until the peak is again reached."

How winter idleness is being fought with unusual success in Rochester, New York, is told in a recent editorial in *Engineering News-Record*. The campaign has been carried on primarily by the Community Conference Board sponsored by the Chamber of Commerce.

"This board is made up of men representative of various interests in the construction industry and began work in the fall of 1921. Its effectiveness was shown almost immediately. During the first winter of 1921-22, as a result of publicity, urging winter remodeling and redecorative work, over 17,000 days of work were provided. An increasing amount of this work has been done every succeeding winter. In 1921 the December-March permits for building were 20 per cent of the year's total. In 1924 they were 27 per cent of this total."

Winter-time Bargains for Builders and Owners

IN an address before the New York Building Congress, John W. Lowry told how "an expenditure of $3,863 for protection of workers and materials saved $87,710 on a job costing $750,000." He explained how the efficiency of bricklayers increased 18½ per cent over the summer before, which accounted for a $5,360 saving, bricklayers bonuses to the amount of $11,260 were eliminated, savings on labor and subcontractors over the previous summer prices amounted to $16,030 additional, and so on through the entire list of savings.

W. J. Barney, president of a large contracting firm in New York City says:

"From our files, I have taken three typical contracts, and the amounts given under the total contract column are practically for the reinforced-concrete structure, the enclosing walls, sash and roof, in other words, for that part of the building which requires protection from winter winds, freezing and cold in the course of construction. Once the building is enclosed, the matter of heating for the finishing trades is comparatively simple, especially if the permanent heating plant has promptly followed up the structural work. In a general way, about 5 per cent of the contract represents the cost of winter protection.

"Total contract, $263,000; time of protection, December-January; cost of protection, $13,000; percentage costs, 5.

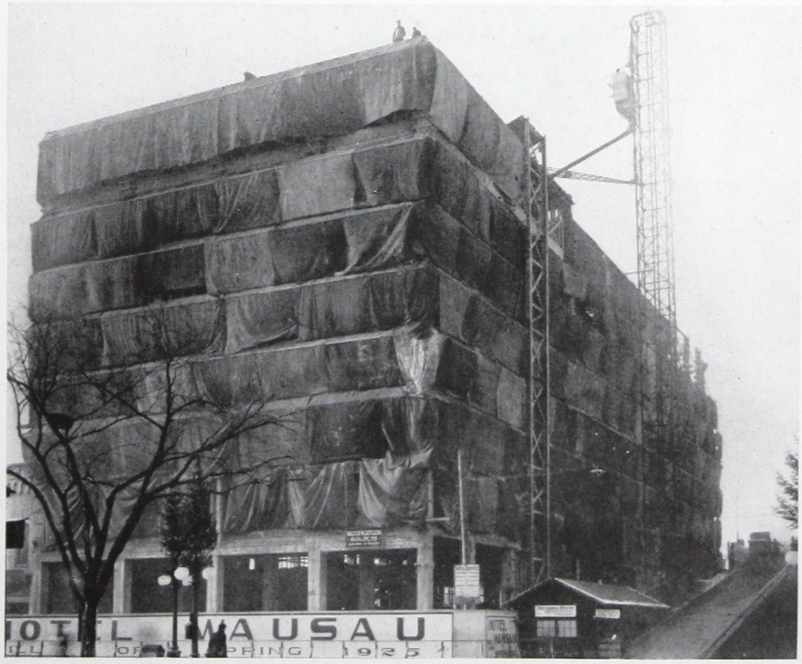
"Total contract, $180,000; time of protection, December-January; cost of protection, $8,800; percentage costs, 4½.

"Total contract, $95,000; time of protection, January-February; cost of protection, $6,300; percentage costs, 6½.

"This, however, does not represent the true cost of winter construction, as the cost of this winter protection, especially under present conditions of the labor and material markets, is more than offset by the lower cost of materials during the winter, the absence of bonuses paid to mechanics and the greater efficiency of mechanics under conditions when work is not so plentiful."

Mr. Barney further found economies, in that lumber purchased in June cost approximately 10 per cent more than if purchased in November, and particularly ¾ inch boards which are largely used for form construction cost $1 per thousand less in November than in August. He also found important savings in common brick for curtain walls, reinforcing steel, and received the benefit of a seasonal drop in cement. His idea of the efficiency of labor working on winter jobs is given in the following paragraph:

Placing concrete in 13th floor of the new Detroit Free Press Building January 16, during a snow storm.



Summer temperatures can be maintained in an inclosure like this, affording comfort to workmen and safety to fresh concrete.

"We know that it is now possible to obtain practically all laborers and skilled mechanics, especially in reinforced-concrete construction, at the established union rates, and that, moreover, the men are anxious and willing to work efficiently and skillfully and have interest in holding their positions."

During the past five years, the Dwight P. Robinson Construction Co. has been on at least 20 jobs where excavation, concrete and masonry work was done in winter months, but as D. D. Dick, Assistant Construction Manager for the company tells *American Contractor* "in no case did the cost of protection amount to as much as closing down the job nor equal the carrying charges on the investment during the delay in the completion of the work," while Alfred S. Alschuler, a prominent Chicago architect tells the same magazine that "it is certainly 'conservative' to say that winter construction will cost an owner no more than summer work and in many cases owners will profit by proceeding with their work regardless of weather conditions."

To the contractor who fears that his labor will be slowed down by cold weather, A. P. Greensfelder, Vice-President of the Associated General Contractors says:

"Have you ever stopped to realize how summer heat affects your labor and slows up their production?

"One quarryman has declared that he would rather shut down his quarry when it is 100 degrees in the shade and operate it a month longer in the winter time when it is only 20 degrees in the sun.

"I am inclined to agree with him that his efficiency per man-hour would be greater in the cold weather than in the extremely hot months."

On the same subject, Sanford E. Thompson of the Hoover Committee compares labor productivity in summer and winter. The comparison shows an average of approximately 15 per cent saving in brick masonry labor, about 6 per cent saving on reinforcement labor, and about 11 per cent saving on concrete labor while the form labor costs about 8 per cent more on account of the difficulties encountered by carpenters in handling tools and nails when encumbered with heavy clothing and gloves.

Halbert P. Gillette, Editor of *Engineering and Contracting* writes:

"When consideration is given to all the elements of costs, then winter building construction becomes so clearly economic that even the most deep set habit of aversion to it cannot survive."

Changes In Art

THE changes in methods and improvement in construction equipment have been scarcely less astounding in the last generation than the discoveries in medicine and chemistry and the inventions of machines and improvements of methods in the fields of industry and transportation.

On this subject J. Reid Kilpatrick, Vice-President of Geo. A. Fuller & Co., of New York City says:

"Excavating is now as simple and as easy in the winter as at any other time of the year. We never see hand excavation any more. It is all done by steam shovels which can work in frozen ground very nearly as easily as they can when the ground is soft. The placing of the concrete is not a serious problem. It is a very simple matter to heat the aggregate. We have poured concrete at 40° below zero in Canada.

"The opinion has existed for some time that steel work in winter is particularly hazardous on account of the ice and snow. I have investigated this and find that there is really no difference.

"We can lay brick at 23 to 25° above zero. As our various foremen have told us, they are convinced that we can go considerably lower than that if necessary."

In another article Mr. Kilpatrick states that:

"As regards New York, we have prepared careful statistics extending from 1912 to 1922, a 10-year period, and we have found the average length of time that a winter building program would be rendered impossible due to temperature conditions is 14 days. Winter work is not new, revolutionary or untried. We have been doing it in New York on big jobs for the last 23 years."

C. S. Hill, Associate Editor, *Engineering News-Record*, in a study of the situation writes:

"In no respect, perhaps, has the contractor been so much aided in his ability to work in winter as by wide invention and improvement in construction equipment. Let us look at a single illustration. Without the modern highly improved hoisting machine and the pneumatic hammer, steel framework would have fallen considerably short of its present possibilities of being successfully prosecuted in winter.

"It is practicable to consider only broad phases in equipment development as it has affected winter work. Machines and even types of machines are too numerous to be considered individually. The phases are: (1) size and power, (2) mobility, (3) mechanical perfection and, (4) special-purpose machine invention.

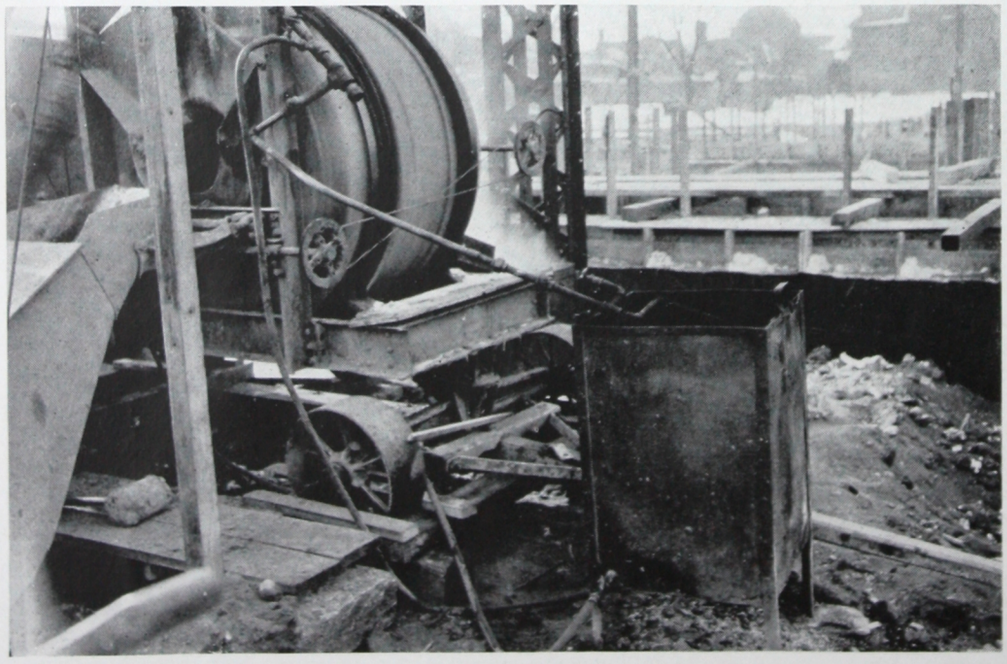
"Increase in size and power aids the winter builder in a number of ways:

1. Larger shop-fabricated units can be handled, as in steel erection and form construction, thus reducing manual operations in the field.
2. In concrete work larger containers, buckets and cars conserve the temperature of heated concrete.
3. In excavation the heavier shovels readily dig frozen ground and with motor trucks, larger cars and more powerful derricks the frozen earth and rock can be loaded and hauled in larger pieces and so reduce secondary reduction in pit and quarry.

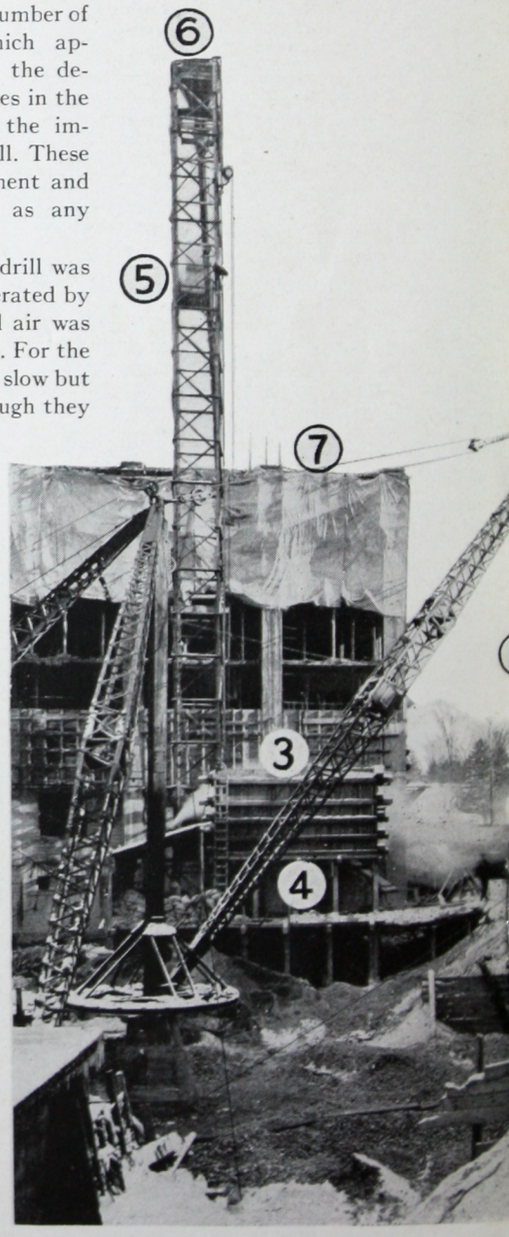
"Summed up in a sentence, the present high development in variety, power, mobility and mechanical perfection of construction equipment reduces the necessary human element in winter construction."

The fiftieth Anniversary Number of *Engineering News-Record* which appeared April 17, 1924, traces the development not only of machines in the preceding half century but the improvements in methods as well. These stories of advances in equipment and methods are as captivating as any popular fiction.

The first percussion rock drill was introduced in 1849. It was operated by steam at first but compressed air was substituted a year or two later. For the first years, improvements were slow but these original drills, crude though they were, were the forerunners of our present day drilling tools of near mechanical perfection and compactness.



A convenient and effective device for heating mixing water.



Modern machinery defeats cold weather. Follow th
the cars to the forms

# of Construction

The first patent for a power shovel was granted by the U. S. Government in 1839 to Wm. Smith Otis. It was operated by steam, whereas modern excavating machinery is operated by electricity, gasoline engines, compressed air, or heavy oil engines of the Diesel type, as well as steam.

In reviewing the development of construction equipment, the Anniversary Number of *Engineering News-Record* states:

"Material costs and labor rates have steadily gone up but the unit of production has as steadily increased, so that, as William Mulholland points out on another page of this issue, 'the cost of completed work remains about the same, mainly due to a great improvement in mechanical means of doing work.'

"This is the great contribution of the machinery builder to the progress of the past half century. For the American contractor of today, the equipment manufacturer has provided an efficient machine at a reasonable price for almost every one of the scores of operations formerly done by hand. In no other country in the world is the range of selection so wide and the design and materials so perfected."

It is sometimes said that materials of construction have changed but little since ancient times. It is true that materials used by the ancients are still in use but many new materials have been introduced in the last few decades. The first portland cement made in this country was produced in 1872. The production of rolled steel shapes in large quantities did not begin until 1890. The influence of reinforced concrete became important only about 1910—and since then a number of buildings 20 stories or more in height have been constructed entirely of reinforced concrete. On this subject the Hoover Committee says:

"Steel construction could hardly have attained its present independence of the weather but for the hoisting engine and the use of air-driven tools. The former was adapted for building purposes about 1895. It not only lifts heavy parts to place without the risk attendant upon raising by hand, particularly in times of cold and wet, it also makes it possible to use much heavier members than could practically be raised by hand, and thus increases the amount of fabrication which can be done in the shop under cover."

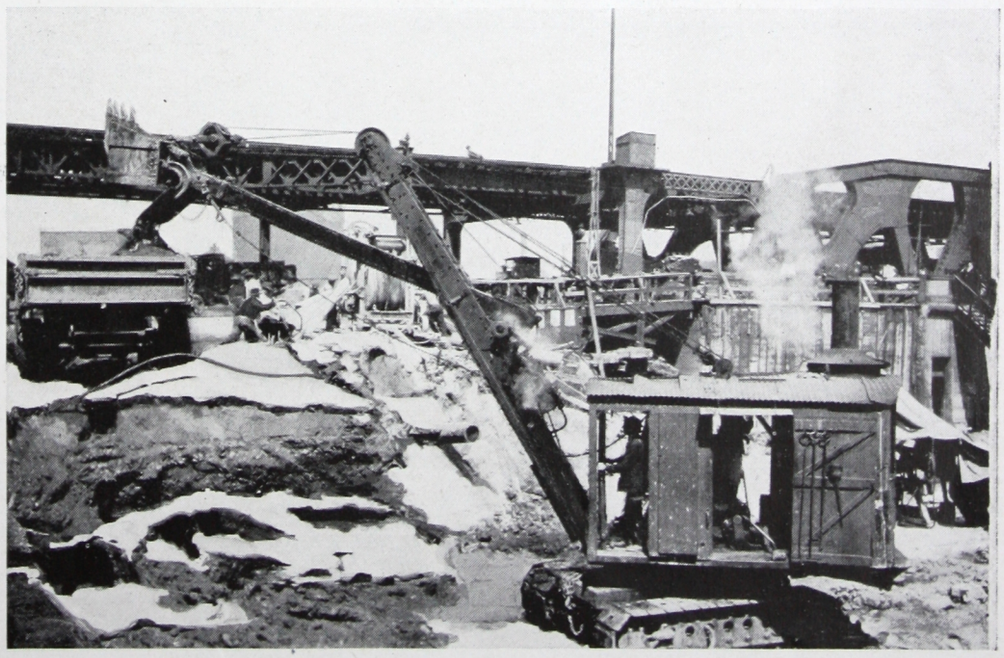
The Hoover Committee outlines the developments in electrical power which eliminate many of the difficulties attending the operation of steam boilers under cold weather conditions. It points out that steam and electric hoists have eliminated many of the dangers of accidents so common when labor was used to carry heavily loaded hods up uncertain ladders. The Committee also remarks on the effective use of compressed air in building operations.

Continuing, the Committee reviews the progress of reinforced concrete in building construction as follows:

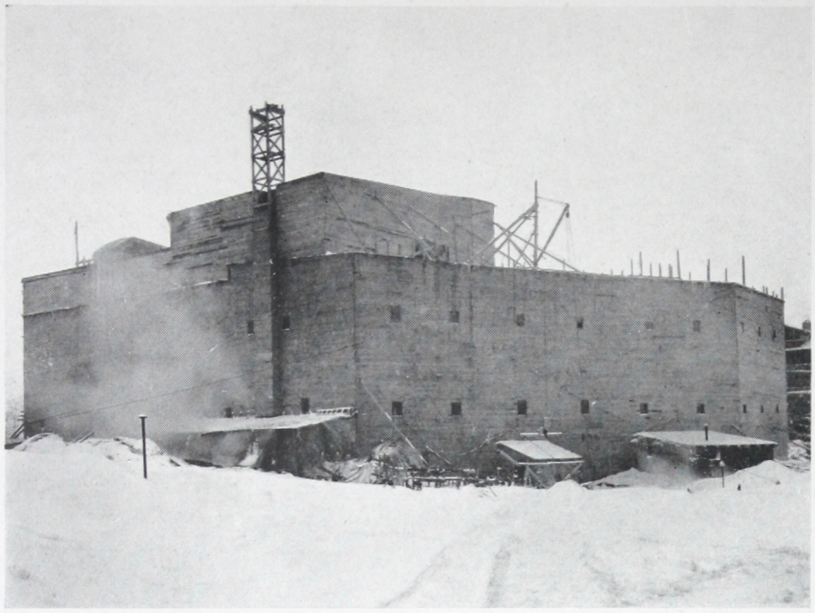
"The only other recent development which rivals structural steel as an improvement in building construction is that of reinforced concrete. Reinforced concrete was the subject of much experimentation in the eighties and nineties and came into general use between 1900 and 1910. It now competes with structural steel in practically all fields where the latter has been used, choice of the two materials depending on such factors as availability, cost of transporting materials, type of labor supply, adaptability to special purposes, or personal preference. Building with concrete essentially is more subject to climatic handicaps than with structural steel, but an elaborate technique of preparation and protection has been developed which makes the former practically as independent of the weather as the latter, and far more suitable for cold weather construction than many older combinations of materials. More than any other construction type, it has been fruitful of new equipment and methods which apply also in other fields of work, and has thus been both directly and indirectly influential in extending the construction season."

Even the concrete mixer, we read, has only been in common use since about 1900, and the point is made that if it were not for mechanical mixing of concrete, it would be highly uneconomical to use in winter weather, since by the machine process, heated materials are given but a fifth of the time to cool that they would undergo in hand mixtures. Reinforcement steel is now usually cut and bent at the mill and delivered to the job ready for placing. This feature further lessens the handicap of winter construction.

course of the raw materials by the numbers, from
as finished concrete.



Frost has little effect on modern excavating machinery.



A temporary wooden shelter made it possible to build the Lake Placid Club under summer conditions in the dead of winter.

NEARLY all plastic materials such as concrete, mortar, or plaster must be protected from freezing. There is no danger of unsatisfactory results in using such materials in cold weather if they are adequately protected against freezing temperatures for a few days.

Engineering News-Record says:

"Winter methods in construction are operations especially directed toward reducing exposure and eradicating frost. They are increasing frost resistance, thawing and removing snow and ice, heating and insulating forms, blanketing exposed surfaces, housing, heating enclosed spaces.

"Addition to concrete of certain compounds, such as salt, to lower the frost point or calcium chloride to quicken setting, is effective where only a few degrees of frost have to be guarded against. In general these chemical hardeners have a field limited to isolated small operations or especially thin sections or slabs at temperatures, let it be repeated, not much below freezing."

When very severe cold weather is to be encountered more effective methods must be used to insure against damage by frost action. Not only must the mixing water be heated, but the fine and coarse aggregates as well. Further, in very severe weather the slight insulation provided by a light covering of hay, sawdust or burlap will not be sufficient. The work must be covered and supplied with artificial heat under the covers from salamanders, boilers or some other reliable source of heat.

Concrete aggregates piled over a grill work of steam pipes like this can be kept hot, regardless of weather conditions.

How Contractors

The Turner Construction Company of New York has done many millions of dollars worth of concrete construction during the severe New England winters and their requirements for cold weather construction are published in *Engineering and Contracting*. An extract from the article follows:

"Winter work has been a regular procedure for contractors experienced in reinforced concrete construction for many years. Such contractors have found that it is necessary to supply proper protective equipment, but less experienced contractors do not always realize the danger resulting from lack of proper protection. The use of a definite specification is necessary if the owner is to have reasonable assurance of getting an undamaged building at the completion date contained in the contract.

Cold Weather Protection for Reinforced Concrete Work

"(1). The contractor shall furnish and install at the building boiler capacity of at least 50 h.p. licensed for 80 pounds steam pressure. This boiler capacity shall always be available for the sole purpose of supplying steam for cold weather protection.

"(2). All fine and coarse aggregate shall be entirely freed from frost and warmed either by storing in an enclosed space properly heated or if not stored in an enclosed, heated space then by piling over perforated steam pipes, having a diameter of 1½-in. and spaced about 4 ft. C to C or shall be heated by inserting 1½-in. perforated pointed steam pipes into the pile. The material piles shall be steamed during the day preceding the placing of concrete and while concreting and shall be covered with canvas during the night preceding the placing of concrete.

"(3). All mixing water shall be heated by injecting live steam into the water barrel at the mixer through a pipe at least 1½-in. in diameter.

"(4). A steam line shall be carried up with the form work and immediately before starting to place concrete all forms and steel reinforcing shall be thoroughly cleaned and warmed by live steam supplied through a steam hose.

"(5). Before starting to concrete the columns of any story or the floor supported by such columns, the contractor shall hang canvases to enclose the section of the story to be concreted, being careful to maintain an air space between the exterior faces of the concrete and the canvas curtains. Canvas curtains shall be well lapped to exclude wind and shall be large enough to reach well below the surface of the floor supporting the columns which are to be concreted.

"(6). Before starting to place concrete, salamanders containing coke fires shall be placed inside the enclosure at proper intervals to maintain a temperature of about 70 deg. at the under side of the floor slab. This will generally require about one salamander of usual size to each 300 sq. ft. of floor space. One salamander shall be placed near each exterior column unless temperature is below 20 deg. when two salamanders shall be placed one each side of each exterior column. On windy days use two salamanders at each exterior column on windward side of building.

"(7). Holes about 8 in. by 12 in., one to about every 300 sq. ft., shall be formed through the floor slab by cutting holes in the floor form and inserting a

Defeat Cold Weather

wood frame in the concrete. These holes to be made larger at the top of the slab than at the bottom of the slab in order to hold the concrete which will later be used to fill them. These holes permit hot air to rise into the space between the top of the slab and the canvas covers described in the next paragraph.

"(8). As rapidly as the floor slab is concreted it shall be covered by canvas covers well lapped and supported about 6 in. to 18 in. above the surface of the concrete by a framework supported on the wood frames around the heat openings or on the steel reinforcing rods which project above the floor line at columns. These top covers shall be well lapped over the side curtains.

"(9). Full continuous heat is to be maintained in each section for 110 hours after the concrete is poured, except should the outside temperature fall below 20 deg. F. the heating shall be continued for one day for each day on which the temperature falls below 20 deg., but not to exceed two additional days of 24 hours each.

"(10). When using beam and girder construction top covers shall be kept in place for 48 hours, but with flat slab construction they shall be kept in place for 72 hours, except that top covers may be removed between 8 a. m. and 5 p. m. on days when the temperature is above 35 deg. to permit of setting column forms, but shall be replaced at 5 p. m.

"Side covers shall remain in place as long as heat is continued, except that after 48 hours the curtains outside of exterior columns may be removed one at a time for only sufficient time to strip the forms from the exterior columns after which they should be immediately replaced."

There are other satisfactory ways of heating aggregates and water than those described in the Turner Company Specifications. Aggregates can be heated to very good advantage by storing them in bins constructed so that steam pipes can discharge live steam into the aggregates around the bottom of the bin and over the discharge opening. In this way aggregates may be kept hot as they are delivered to the mixer. Instead of heating water by discharging live steam into a water barrel or storage tank it can be heated by passing it through a boiler or in a heater designed for the purpose.

The technical press and builders' journals contain many striking examples of important structures erected during the winter months in our Northern cities. A January drive through the outskirts or suburbs of Detroit, Chicago, New York City or any large city will show that residential building does not halt for snow and ice.

The Northern Ontario Building, situated right in the heart of Toronto's financial and office district, is not only the highest concrete building in the British Empire, but architecturally is one of the most beautiful office buildings in Toronto. *Municipal Improvements* says of this building:

"It was completed within nine months of the first excavation, the work being carried on all through the rigorous winter months.

"On October 23, preliminary excavation was under way and was practically completed in two weeks elapsed time. By November 13, pouring of concrete for the foundation walls was progressing rapidly and a placing tower had been erected and pushed with especial vigor, so that by December 4 operations were being carried on well above street level.

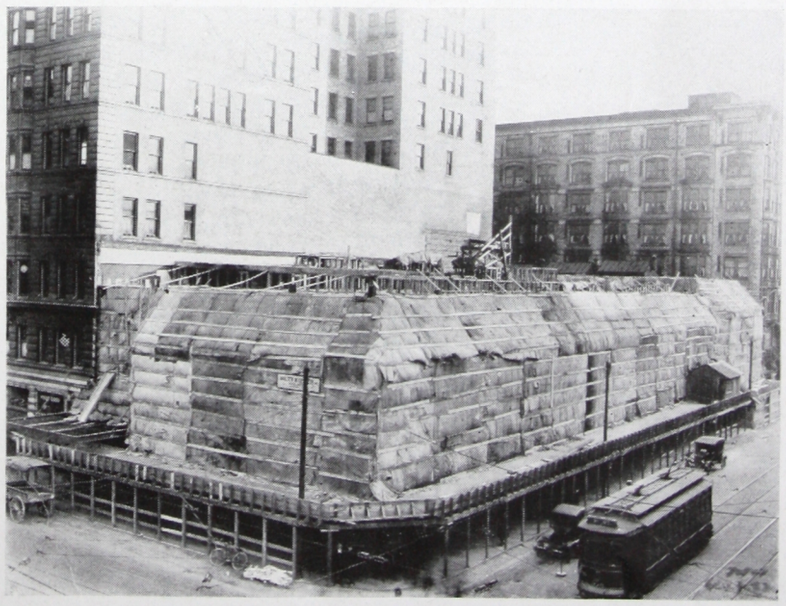
"Here King Winter began to assert himself without, however, impeding in any way the progress on the structure. Tarpaulins were called into use to protect fresh concrete from cold and snow and other usual precautions were taken to guard against the effects of low temperature. An average of practically a story a week was made in the dead of winter."

Hay carefully packed around forms and spread over freshly placed concrete affords protection against temperatures slightly below freezing.

When fire swept away an important wing of the "Chateau" at Lake Louise, Alberta, in the fall of 1924, officials of the Canadian Pacific Railway in charge of the resort realized that no time could be lost in erecting the new 10-story building with 300 rooms to accommodate the next summer's "rush" of tourists. In describing the work, *Railway Age* says:

"To permit concreting to proceed without interruption during the winter an outside boarding was erected around the entire building, approximately five feet away from the building line; this consisted of 2 by 8-inch studs spaced at 33 inch centers in the lower stories and 2 by 6-inch studs in the upper stories. These were capped, strutted and tied to the steel spandrel beam at each floor level and were sheeted on the outside with common boards and lined inside with sheeting of heavy tar paper cleated to the sheeting and studs. Cheese-cloth windows were left at frequent intervals to give some natural light, although artificial light was used both day and night for construction work.

"Heat was supplied to this enclosure from a central heating plant through temporary steam coils placed on the walls to offset outside temperatures as low as 50° below zero."



A temporary housing of tar paper over a wooden frame affords protection to workmen and freshly placed concrete.

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